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R&D
Research & Development

CAREER SATISFACTION
Would you do it again?
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EXECUTIVE OF THE YEAR Page 52

DuPont's Edgar Woolard leads environment crusade

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Program instruments on time and under budget

Chemist Lauren Rice is one of many researchers who say they made the right career choice

INTERNATIONAL MAGAZINE OF RESEARCH AND DEVELOPMENT

R&D

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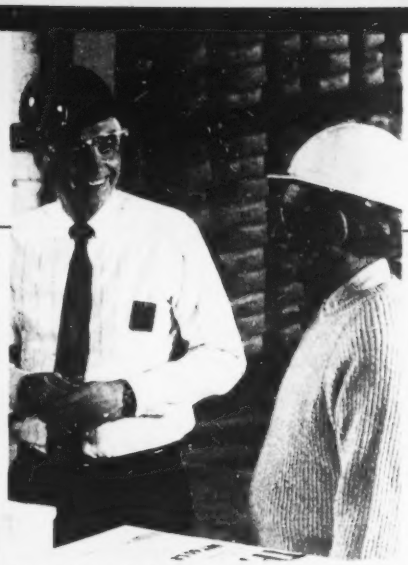

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Chemist Lauren Rice says if she had to do it all over again she would choose the same profession, and so would nearly three-fourths of the more than 4,000 respondents to R&D Magazine's *first Career Satisfaction Survey. See story on page 40. Photograph by Robert Keeling.*

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R&D BUSINESS

Three agencies agree on emerging technologies

JAPAN'S MINISTRY of International Trade and Industry (MITI) and the U.S. Departments of Commerce (DOC) and Defense (DOD) all agree that development of new materials, advanced semiconductor devices, and high-performance computing systems are the lead items to long-term economic and defense superiority.

In its *Emerging Technologies—A Survey of Technical and Economic Opportunities,* the DOC forecasts $325 billion in U.S. sales and $700 billion in combined worldwide sales for these three technologies by the year 2000. Based on a survey of government and industrial experts, the DOC concludes that U.S. research efforts in these categories lag similar efforts by Japan.

Although the main purpose of DOD's recent *Critical Technologies Plan* is to outline a program that will enhance the performance of weapons systems, a strengthening of the U.S. industrial base is added to this year's technology selection criteria. Both the DOC and DOD reports cite their interdependence on dual-use technologies and the resultant benefits in economic and defense areas.

DOD also recognizes the importance that U.S. Dept. of Energy provides through its national laboratory system.

DOC, DOD, and MITI list other critical technologies, but at a lower interest level. DOC lists nine additional emerging technologies, including biotechnology, high-density data storage, and flexible computer-integrated manufacturing. DOD lists 17 additional technologies, including machine intelligence and robotics, photonics, and superconductivity.

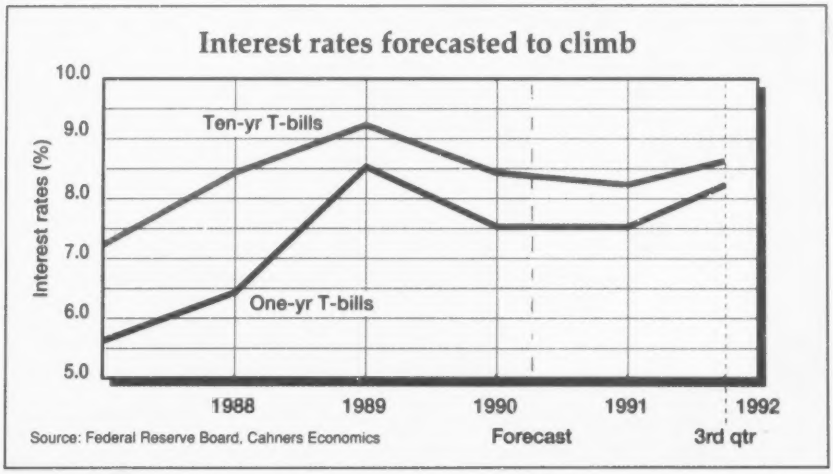
MITI lists aerospace, energy and quantum engineering, and biotechnology as other emerging technologies, but the working group at MITI has low expectations about their short-term usefulness.

For copies of the reports: DOD's *Critical Technologies Plan,* 202/695-4131; DOC's *Emerging Technologies,* 202/377-8090. *—Tim Studt*

Thermal analysis market to grow 15% annually

THE worldwide market for thermal analysis instrument sales will exceed $300 million in 1993, according to Strategic Directions Intl., a Los Angeles-based management consulting firm.

The most popular thermal analysis technique is differential-scanning calorimetry (DSC). The simultaneous use of DSC and dielectric thermal analysis is the fastest growing market.



***Cahners Economics forecasts** that easing inflation will hold interest rates steady through the end of 1990, and economic growth will drive the rates up in 1991.*

Steady interest rates helps high-tech growth

IN SPITE OF their recent rise, interest rates are forecast to stabilize and even lower slightly through the end of 1990, according to Newton, MA-based Cahners Economics.

Strong domestic economic growth and investment in the first quarter of 1990, rising foreign interest rates, and expectations of higher inflation rates contributed to the early-1990 rise in interest rates. However, lower inflation rates will steady interest rates through the last half of 1990, says Kermit Baker, director of economics for Cahners Economics.

Traditionally stable Japanese interest rates have risen 1.5 percentage

CAREER SATISFACTION

Would You Do It Again?

R D

Here's what you tell us about R&D

✓ Three out of four researchers would choose R&D again.

✓ Two out of three researchers are satisfied with their jobs.

✓ Best part of the job: solving challenging problems.

✓ Biggest beef: too much bureaucracy.

✓ Most employers do not reward researchers and managers equally.

✓ Nearly half of R&D employers are not open to new ideas.

The research and development field has frustrations. But most of its members would choose it again, according to *R&D Magazine's* first Career Satisfaction Survey.

*By **Elizabeth Dougherty**, Assistant Editor,* R&D Magazine

LAUREN RICE likes solving challenging problems in closed-cell foam product development. She did it for eight years at Uniroyal Plastics Co., Mishawaka, IN, and recently started doing it for Rubatex Corp., Bedford, VA.

If she had to do it all over again, would she choose the same profession? Absolutely, and so would nearly three-fourths of the more than 4,000 readers who answered *R&D Magazine's* first Career Satisfaction Survey, which appeared in the December 1989 and February 1990 issues.

Although research and development has its frustrations, nearly two-thirds of respondents are satisfied with their jobs. The researchers are representative of *R&D Magazine's* domestic readership. (We use the term "researchers" to refer collectively to the survey's respondents.)

Rice, 30, says she was "extremely satisfied" with her job developing products, such as flotation devices and wrestling mats, with PVC nitro-rubber closed-cell foam for Uniroyal, but she also felt a lot of pressure being the most experienced technical person in the company's Foam Products Div. When a headhunter sought her out to fill an opening for a senior chemist developing products, such as gaskets,

***Lauren Rice** checks a roll of PVC nitro-rubber closed-cell foam that is used as insulation in submarines. She spent eight years at Uniroyal Plastics developing new products for this type of foam and recently began a similar job at Rubatex.*

The majority of researchers like what they do, especially solving challenging problems.

with closed-cell foam at Rubatex, she decided to go where she could work with more experienced researchers.

"A lot of people would dream about being in that position [being the most experienced researcher], but with two small children, I don't need any more pressure," Rice says. Her daughter is 2½ years old; her son is 5½ years old. Her husband, a purchasing agent, planned to look for a job after the family moved to Virginia at the beginning of June.

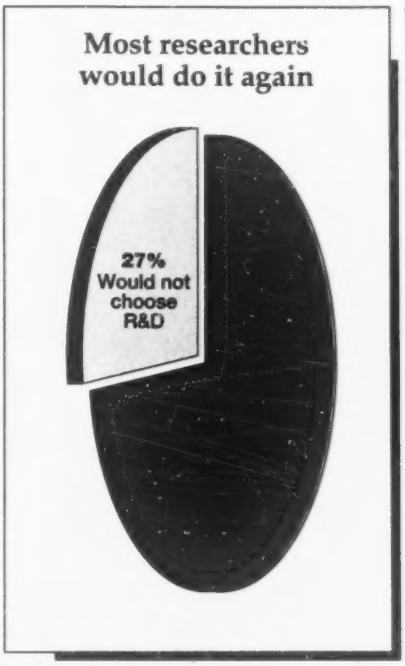
"I liked my job. That's why I chose a similar position," she says. "I don't want to get out of the business."

After earning a bachelor's degree in chemistry from Olivet Nazarene Univ., Kankakee, IL, Rice worked as a PVC compounding technician for five months and considered teaching or working on her doctorate. She "fell into" her job at Uniroyal when her father-in-law referred her to the firm.

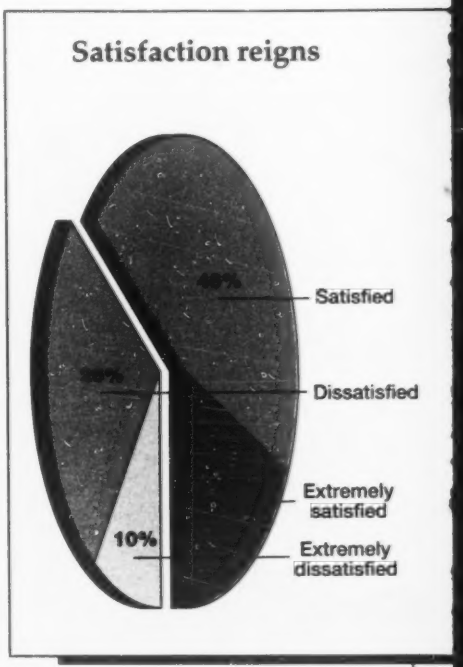
At Uniroyal, she went through five titles. "My responsibilities were the same all along. It was just a matter of money," says Rice, who fell into the same salary range—between $40,000 and $49,999—as about a fourth of the survey's respondents.

Rice likes the challenge of developing new products. "You have a different type of pressure. You're not fighting fires," she says. "You can be a lot more creative. This gives you more freedom."

Solving challenging problems is cited most frequently as one of the three most satisfying job aspects (see accompanying figures). This is true in all age groups and for researchers in industry, government, and consulting. University researchers, however, list the ability to work independently above solving challenging problems.



Nearly three-fourths of researchers say if they had to do it all over again, they would still choose R&D.



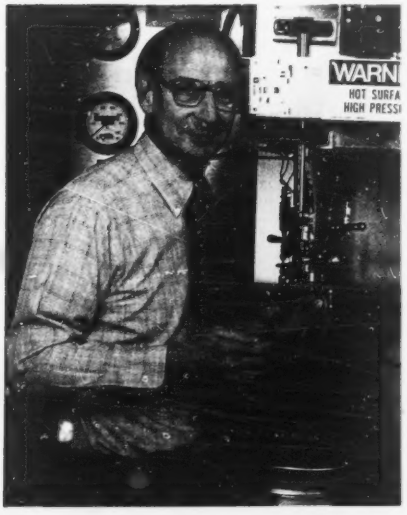
Nearly two-thirds of researchers are satisfied with their current jobs. Fully 18% are extremely satisfied.

The ability to work independently, along with "doing what I'm good at" and "the people I work with," are the next most often cited satisfying job aspects. As researchers get older, they are more likely to include "doing what I'm good at" and "being recognized in my field." The ability to work independently and a flexible schedule, two of Rice's choices for most satisfying job aspects, are cited more often by women than men.

"I love doing chemistry—using my creativity and innovativeness to produce something new or modify something that could have a global impact is exciting!" says C.J. Opalka, a senior research chemist at Sterling Research Group, Rensselaer, NY.

Gary Douglas, a mechanical design engineer at Rockwell Power Systems, who is contracted to Sandia National Laboratories, Albuquerque, NM, says of his job—"Independence, appreciation, good pay. All this and fun, too!" Douglas has cradle-to-grave machine design and project management responsibilities. "I encourage all young people I know to choose the engineering profession."

Resa Brna, a chemist at Air Quality



"I feel very fortunate to have the opportunity to work on problems of global importance in an organization that has both the resources to attack these problems and a firm commitment to R&D," says Carl Scouten, 40, a senior scientist at Amoco Oil Co., Naperville, IL.

Services, Pittsburgh, says—"I have always wanted to be a chemist, even when I was told by my high school guidance counselor that I couldn't."

"I like to apply what I learned in school and actually see it work," says Sarah Ann Gallagher, a scientist at Sherwin-Williams, Cleveland.

Jay Cheek, a research physicist at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, says—"Because of some of the things I've done, the country is in some small way a better place to live. What more can one ask from his chosen profession?"

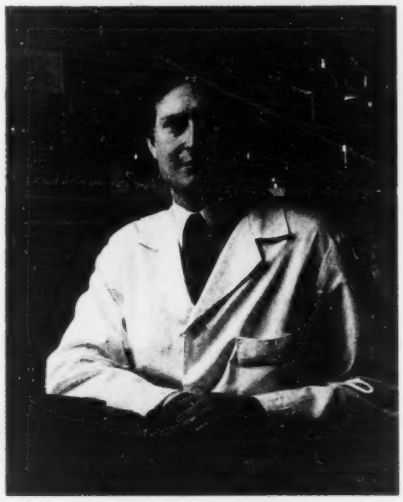
Frustration

Nearly 60% of the respondents work for organizations with 500 or more employees, and 15% work for the government.

It's not that surprising then that "too much bureaucracy" is a runaway favorite choice for one of the three least satisfying job aspects. About half the respondents in industry and at universities and about four out of five government employees cite this frustration (see accompanying figures).

"Senior 'researchers' don't do much research these days," says David Schryer, a research chemist for NASA Langley, Hampton, VA. "Instead, we hustle for funding, go to meetings, and write reports. This is not unique to NASA, but is fairly common throughout science."

"When you work for a big company (they're all the same), the paperwork cycle is long, and there are a lot of processes that you have to go through to get things implemented," says Gail Brinkman, an engineering chief at General Dynamics, San Diego.



"Americans need to work harder if we want to compete with the Asians," says Steven Schill, 31, a product manager for Leybold Inficon Inc., East Syracuse, NY.

Vic Gill, a manager at Westinghouse, Cincinnati, says—"The demands on a chemist are more legalistic and bureaucratic than technical, which is the primary reason one enters the field."

Not enough appreciation, no advancement opportunities, and inadequate staff are the next most frequently cited least satisfying job aspects after too much bureaucracy.

"The profession is satisfying," says Janice Chambers, an associate professor of biology at Mississippi State Univ., Mississippi State. "The red tape and lack of recognition for hard work sometimes becomes demoralizing."

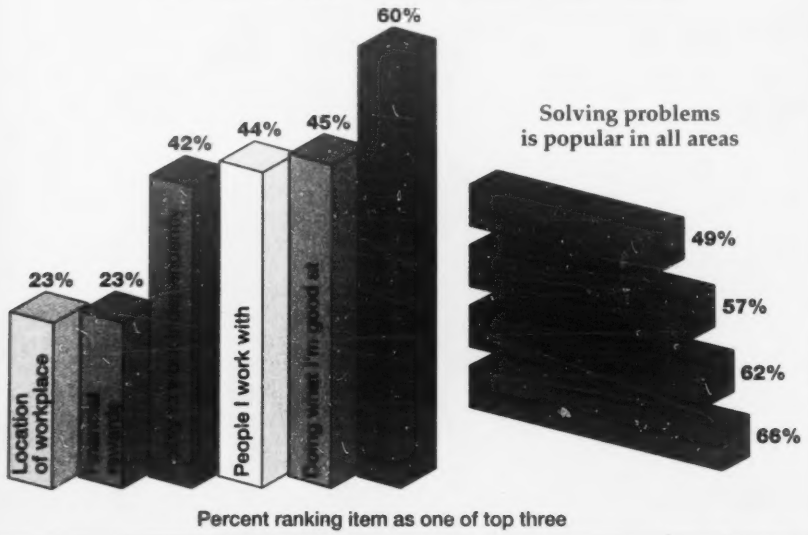
"Promotion to upper level management is very difficult for R&D people," says Bob Crooks, a chemist at Plasti-Kote Co. Inc., Medina, OH. "It's almost always sales, marketing, and finance people who are promoted."

Many researchers don't enjoy living with a negative image. "Our society denigrates scientists," says one chemist. "You're either a 'mad scientist' or a weirdo nerd." A technical director adds—"Chemists have become the bad guys in industry and are burdened with too many regulations."

Lack of funding and low salaries are pressing problems.

"It bothers me that an *average* lawyer or MBA makes more money for a field that is much less demanding and far less useful to society in the long run," says Barry Neyer, a senior diagnostic specialist at EG&G Mound, Miamisburg, OH.

John Hunt, a professor of genetics at Univ. of Hawaii, Honolulu, says—



Solving challenging problems *was the top choice when researchers were asked to list the three most satisfying aspects of their jobs (left). This is true in industry, government, and consulting settings (right). It was second only for university researchers, who ranked working independently as their top choice.*

'Too much bureaucracy' tops researchers' list of least satisfying job aspects.

"The dependence on extramural funding to do research makes university research unattractive. The Federal funding (NIH, NSF) peer review system only worked where there was lots of money. Now innovation and true research are being stifled."

Competitive edge

Although the survey did not ask specifically about issues like competitiveness, industry took a beating for poor, short-sighted management. Researchers often expressed concern over the effects of management's approach to research on product quality and the nation's competitiveness.

"America is losing its technological edge to a glut of MBA graduates whose idea of long-range planning is to keep stockholders happy for another month," says one chemist.

"I wish business management in the U.S. had a better understanding of the engineering/product development process. America would be more competitive if the MBAs were MEs also," says Jim Dockendorff, a transducer design engineer at Stavely Sensors, East Hartford, CT.

Sterling Beck, a physicist and development engineer at Boeing Aerospace & Electronics, Seattle, says—"It is getting more difficult to do a job right! With the strong emphasis on profit, quality is increasingly stifled."

"We must focus our efforts on the education system," says John MacPhee, 48, director of R&D sensor technology at Ciba Corning Diagnostics Corp., Medfield, MA. "More and more students know less about the great opportunities in the 'real' industrial work. Industry can help by working with the educators."

The effects of leveraged buyouts, mergers, reorganizations, and corporate growing pains also are being felt in the R&D ranks.

"The joy of the work outweighs the pain of the merger. The post-merger years have been painful for all at Unisys," says one manager at the company's Roseville, MN, location.

Michael Fath, who works in market development for Nova, Stow, OH, lists continuous reorganizations as the least satisfying aspect of his job, but he would pick R&D again. "I still enjoy 'selling science,' even in today's atmosphere of MBAs, bean counters, and corporate buyouts," he says.

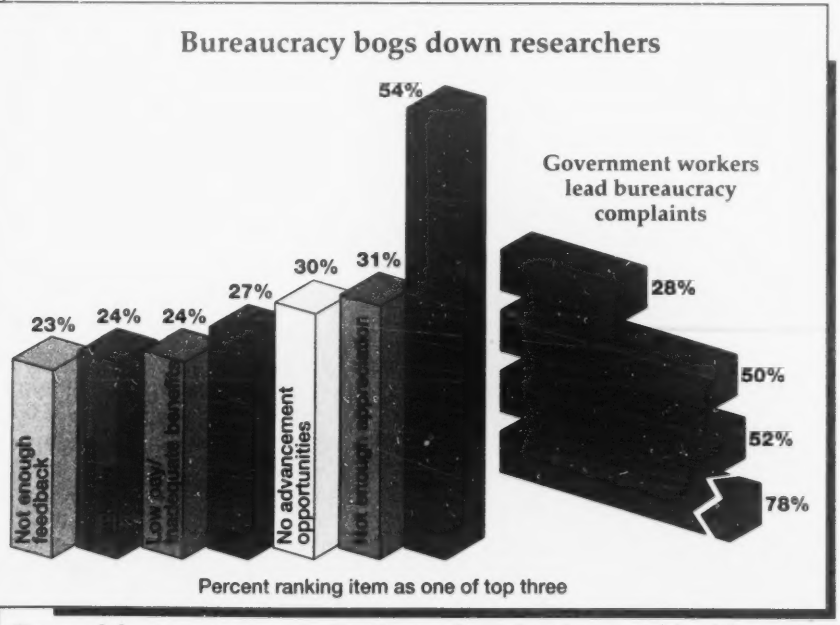
One industrial researcher says—"Our division has had three 'reorganizations' (layoffs) over the past five years that did not touch the hierarchy. The 'working stiffs' are fewer, the work load is heavier, and the urgency greater. Most of our problems are the result of accounting-oriented management, which views engineering, R&D, etc. as an expense to be minimized instead of an investment to be optimized (and exploited)."

Rewarding research

Employers' favoring managers over technical personnel is a bone of contention for many researchers.

Less than a third of respondents agreed that their employers "offer researchers the same rewards and opportunities to advance that it offers managers" (see accompanying figure). Respondents in consulting and at universities are the most likely to agree, while those in industry and government are least likely to agree.

"Promotion opportunities at the top of large corporations clearly go to peo-



***Too much bureaucracy** tops the list of researchers' three least satisfying job aspects (left). About half of industry and university researchers and nearly four out of five government workers rank this frustration in the top three (right).*

Short-sighted management is hurting product quality and overall competitiveness, researchers say.

ple from financial or legal backgrounds, who are certainly no brighter nor do they work harder or better than good scientists and engineers," says M.C. Hamlyn, a technical manager at Allied Fibers, Moncure, NC.

Douglas Chapman, a quality assurance manager at Corn Products, Winston-Salem, NC, says—"The hardest bridge to cross seems to be from 'technical person' to 'management person,' especially in others' minds."

One researcher says: "A scientist becomes a kind of idiot-savant, isolated in the laboratory, where he is sidetracked from any possibility of ever taking on true managerial responsibilities. Meanwhile, people who have no concept of technology, or science, and are often afraid of it assume leadership roles."

Only a fourth of the researchers at the midpoint of their careers (15 to 19 years) agree that their employers offer researchers the same rewards and opportunities to advance that they offer managers. In contrast, two-thirds of those who have been in the profession fewer than five years or in it 35 or more years agree.

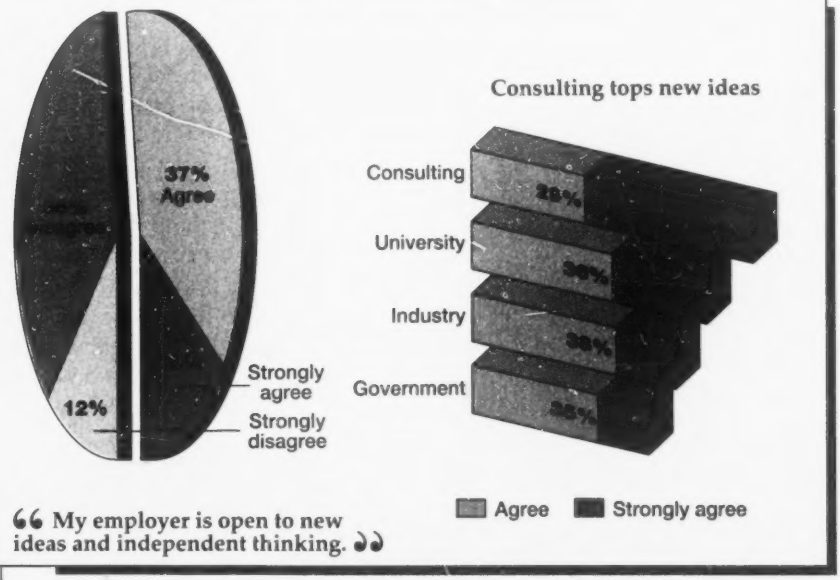
Researchers who make less than $20,000 (39%) or more than $70,000 (45%) and those who work at an organization with fewer than 50 employees (45%) also tend to agree that their employers offer researchers the same rewards and opportunities to advance that they offer managers.

"Chemistry is certainly not financially rewarding, and chemists are regarded as oddballs," says Stan Hunter, 65, director of chemistry and materials at Sierracin/Trans-Tech Div., Sylmar, CA. "I actively discourage anyone from considering a career in the sciences. I say, 'Make money, not progress.'"

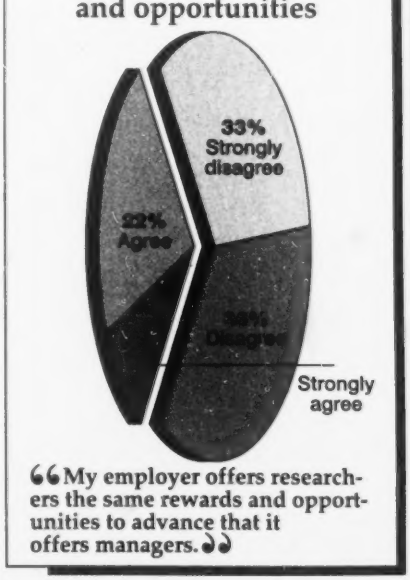
About 62% of respondents say their employers offer management training. Fully 85% pay for continuing education. "My company paid for [me to earn] an MBA in operations management," says Richard Kaner, 41. "Six months later, a position opened up, which I tried for and got, that lets me utilize my new degree." Kaner is a statistical quality control coordinator for Stepan Co., Chicago.

With regard to new ideas, the cup is slightly more full than empty, but not much.

Only 52% of researchers agree that their employers are open to new ideas and independent thinking (see accom-



Slightly more than half (52%) of researchers agree that their employers are open to new ideas and independent thinking (left). Consultants, who often are self-employed, and university researchers agree most often (right).


Rewards and opportunities
33% Strongly disagree
22% Agree
Strongly agree
"My employer offers researchers the same rewards and opportunities to advance that it offers managers."

Less than a third of researchers say their employers offer researchers and managers the same rewards and opportunities.

Employers' favoring managers over technical personnel is a bone of contention for many researchers.

panying figures). In agreement are 72% of consultants, 60% of university researchers, 52% of industrial researchers, and 45% of government employees.

"New ideas are encouraged by giving awards in quarterly company meetings," says Hal Merritt, a technical associate at Planar Systems, Beaverton, OR.

Those who have worked for their employers between five and 19 years (47%) least frequently agree that their employers are open to new ideas, while those who had worked for their employers fewer than five years (59%) or 35 or more years (62%) most frequently agree. Researchers who earn less than $20,000 (58%) or more than $70,000 (63%) also tend to agree.

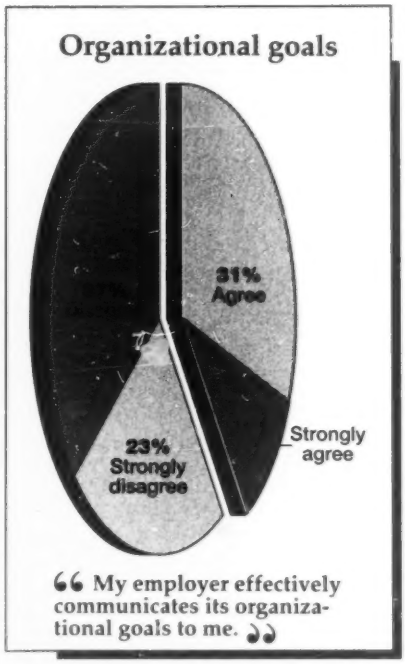
Researchers in organizations with fewer than 50 employees (64%) most frequently agree that their employers are open to new ideas and independent thinking. Fewer than half (46%) of the respondents in departments with more than 500 scientists, engineers, or professors agree.

Almost 60% of respondents say their employers have a formal mechanism for channeling new ideas. These channels include proposals, memos, departmental meetings, patent applications, and presentations.

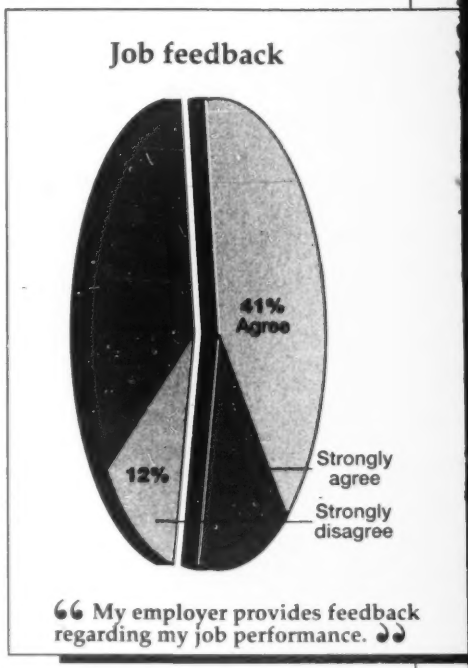
"Scientists fill out research proposals or 'idea note' forms," says J.K. Borchardt, a senior research chemist at Shell Development, Houston. "Periodically, the stack of these is evaluated. About 25% are initiated."

Companies without formal channels often have informal channels.

"Things 'filter up' through informal conversations," says Phil Hamilton, a staff scientist at CNS Research, Cambridge, MA, a company with approximately 45 employees.



Overall, fewer than half of researchers (41%) say their employers effectively communicate their organizational goals.



A majority of researchers (55%) agree that their employers provide feedback regarding job performance.

Eveready Battery Co. Inc., Westlake, OH, does not have a formal mechanism for channeling new ideas, says Andy Pattantyus, a senior engineer. "New ideas have to be sold hard, like swimming upstream," he says. "It's not a job for the meek."

James Hazen, a research supervisor in BASF Corp.'s Chemicals Div., Research Triangle Park, NC, says he can try new ideas "as time allows."

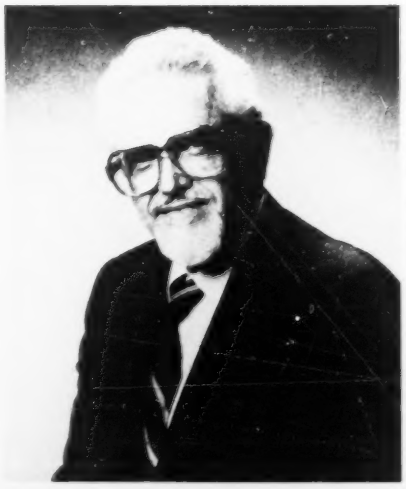
Some formal channels work; others don't, say researchers. One industrial chemist says his company has a formal mechanism "on paper. But in practice, this mechanism is ignored. Ideas come from the top down."

Knowing the game plan

Overall, 41% of researchers agree that their employers effectively communicate their organizational goals (see accompanying figure). Researchers who have been in the profession 35 or more years (47%) or who have worked for their employers 35 or more years (56%) agree more frequently than those who have been in the profession between five and 19 years (38%) or with their employers between five and 19 years (38%).

More than half of the respondents

"My career has been challenging and satisfying," says Marvin Wishman, 65, chemical and analytical research director at Phillips Fibers Corp., Greenville, SC. "Thirty-five years ago, synthetic fiber was in its infancy. A career in one field is hardly possible any longer."



Nearly half the respondents say their employers are not open to new ideas and independent thinking.

"I have had a very gratifying career as a metallurgical engineer. My son is now a materials/metallurgical engineer," says Jim Staley, 55, a senior technical consultant for Aluminum Company of America, Alcoa Center, PA. "My internal recognition came only after many years of 'paying my dues.' I was recently recognized by receiving Alcoa's top technical award."

making $70,000 or more (54%) as well as nearly half of those making less than $20,000 (49%) say they know their organizations' goals. Only 31% of those making between $20,000 and $29,999 say their organization effectively communicates its game plan.

More than half the researchers in organizations with fewer than 50 employees (52%) say organizational goals are effectively communicated to them.

Knowing how you do

A majority of researchers (55%) agree that their employers provide feedback regarding job performance (see accompanying figure).

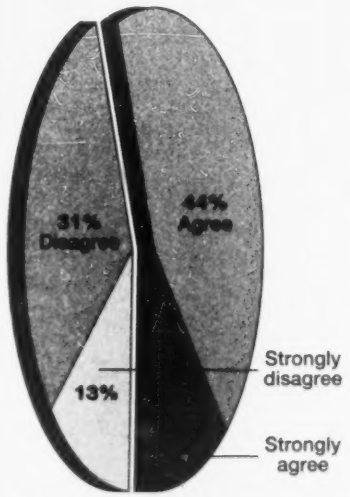
Researchers making less than $20,000 (62%) or making $70,000 or more (63%) agree most frequently that they receive feedback about job performance. Fewer than half (44%) of those making between $20,000 and $29,999 say they receive feedback.

A majority (56%) also agree that their employers are objective in evaluating job performance (see accompanying figure).

Researchers under age 30 (66%) and researchers between the ages of 30 and 39 (61%) agree more frequently than other age groups that they are evaluated objectively.

Researchers who have been in the field fewer than five years (63%), those who have worked for their employers for fewer than five years (63%) or for 35 or more years (64%), and those earning $70,000 or more (67%) also frequently say their employers evaluate them objectively.

Objective evaluation



"My employer is objective in evaluating my performance."

A majority of researchers (56%) agree that their employers are objective in evaluating job performance.

Some researchers are fed up and would choose an entirely different field, such as law or business. Others, who say they would not choose the same profession, frequently indicated that they would choose a different *scientific* area, often medicine or biomedical research. Often researchers felt that they could have had a greater impact helping people instead of improving things.

Physicist A.J. Benjamin, a senior technical specialist at Northrop Corp., Brea, CA, says if he had to do it over he would go into medical research.

P. Lagus, president of Lagus Applied Technology Inc., San Diego, also would go into medicine. "You can be of more use to society and have no shortage of clients," he says. Diane Phelan, a senior scientist working in electrochemistry at Leeds & Northrup, North Wales, PA, says she would have obtained a PhD in biology and conducted cancer research.

B.L. Windsor, a scientist at Parke-Davis, Ann Arbor, MI, says she would go into veterinary medicine instead of chemistry. "My major was in chemistry, but after working, I found that I also have a definite talent in handling animals and developing surgical techniques," she says.

Mark McKinley, a team coordinator at Micro Encoder Inc., Kirkland, WA, says his second-chance career choices include geology, archaeology, and medicine. "I would rather develop science to help people than develop military weapons to kill them," he says.

Dave Pettigrew, a senior chemical engineer at Magnavox, Fort Wayne, IN, says he "probably would have gone into engineering disciplines instead, since most ideas and concepts need a firm engineering basis, as well as a scientific basis."

Some researchers just can't get enough of what they do. R.P. Nordgren at Shell Development Co., Houston, says—"Industrial R&D has been a great career for me. I am retiring after 27 years and will teach at Rice Univ."

"I have been with my present employer 23 years," says A.J. Roccati, a staff scientist at EG&G Inc.'s Washington Analytical Services Center, Rockville, MD. "I am 70 years old and haven't retired because I enjoy my work." **R&D**

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